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AUTHOR Ogletree, Earl J.; Etlinger, Leonard
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ABSTRACT

Results of a survey, concerned with the use of calculators conducted following a calculator workshop, are reported. Respondents were 400 elementary and secondary teachers and administrators. The report includes recommended uses of calculators by grade level and suggestions for staff development. In general, results indicate teachers and administrators consider the calculator as an instructional aid and see many possibilities for its implementation in the classroom. (MK)

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SHOULD HAND-HELD CALCULATORS BE USED IN THE ELEMENTARY SCHOOL: A SURVEY

Earl J. Ogletree & Leonard Etlinger

The availability and decreasing cost of hand-held calculators have put pressure on educators to consider the use of these mini-electronic instruments in the classroom. Whether or not to use mini-calculators in schools has been the major question. The proliferation of professional literature has suggested that hand-held calculators can either enhance or adversely effect students arithmetical achievement, understanding and competence. Although research on the effectiveness of mini-calculator versus non-calculator instruction is limited and inconclusive, it indicates that high achievers profit more than low achievers, and they are more applicable for upper grade than lower grade students.

Opinions on the issue appear to have a common consideration, - i.e., "implementation of mini-calculator programs should be based on sound policy procedure and introduction with caution." Educators agree that teachers need to be aware of how, when, with whom and what conditions calculators can be effectively used in the classroom. They believe that calculators should be used to reinforce basic facts, discover

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new concepts, play instructional games, search for number patterns, solve applicable problems and teach problem solving.

To obtain additional information on the use of calculators in school, the writers conducted a survey of 400 elementary and secondary teachers, and administrators in Chicago and St. Louis following a calculator workshop. The workshop included exploration of and "hands on" experience with hand-held calculators which included discussions, demonstrations, idea exchanging on the principles and practices of teaching with calculators. The workshop was given prior to the survey so as to provide the sample with knowledge of and experience with the calculator. Thus their opinion or evaluation would be based on first hand information rather than hearsay.

A 12 item questionnaire was administered to the participants. The instrument included space for comments.

Findings

The questions were clustered into 7 categories.

The first question dealt with "Should calculators be used to check answers? Fifty-eight percent of the sample stated no, while 42 percent said yes. Those who disagreed commented that the calculator would become a crutch. and "an answer key would be cheaper and more accurate." The participants who agreed believed the calculators would motivate

the students, but they should be able to perform the calculations without the calculator. Both groups agreed that if calculators were introduced students should understand the arithmetical processes and be able to estimate the reasonableness of calculator's answers.

Responses to "Should calculators be used on tests? showed 63 percent felt they should not, while 30 percent felt they should and 7 percent don't know. Although both groups agreed calculators should clearly not be used on tests of basic skills, the former group commented they could be used by high achieving junior and high school students in class and on standardized tests. The latter group believed that since elementary students can practice basic facts (e.g. 9 x 6 - 3) using the calculator, its use on a test is only an extension of that activity.

Regarding the question "Can children learn mathematics from using calculators in school?" 96 percent gave an affirmative response, 4 percent a negative response. The general comments were:

> "children can explore the ideas behind arithmetic, concepts of mathematics, numerical patterns, very large and very small numbers, etc."
>
> "it helps to train basic facts, multiplication facts, order of magnitude, monotony, interval of numbers, and intuitive concepts."

"children will learn because it will be more interesting and fun."

"they can work with very large numbers and experiment with a variety of processes, including the square and root of numbers."

"reinforce place value and number sequence."

Both groups cautioned that the calculator activities must be carefully designed if effective learning is to occur. The 4 percent that rejected the learning possibility of calculators commented that at the elementary grade level arithmetic skills and concepts are best learned by paper and pencil and mental calculations. "The mini-calculator would become a crutch and perhaps a toy." "Students will have to know how to perform mathematical computations when a calculator is not available."

On the question "Should children use calculators before they have mastered the basic facts, 100 percent of the sample stated no. Their qualified comments were:

"children must be able to perform most calculations without calculators."

"calculators can be motivational; this motivation may result in kids learning basic skills."

"children should still learn basic skills without calculators, and use calculators for other types of math learning."

"Possibly older kids who have still not mastered basic skills can benefit by moving on in math and science with the aid of the calculator."

Responses to "Should students be permitted to use a calculator all the time in math and science courses?" showed 97 percent agreed there should be a restriction on its use. Their comments illustrate these restrictions:

"Probably not! Children need to learn facts and basic skills without calculators."

"Math activities should be planned specifically for calculator or for non-calculator usage."

"Children in junior and senior high school should probably be allowed to use calculators in most of their school work and tests."

"Very young children (kindergarten and first grade) should only use calculators in a few carefully designed instances."

The samples' answers to "Can calculators facilitate creative thinking in students?" were in the affirmative. 95 percent agreed that calculators could enhance creativity as supported by their comments:

"There are many fine examples of activities where children use their own creativity together with the calculator in numerical exploration."

"Pencil and paper calculation, particularly when not mastered properly, restricts creativity."

"Students are not limited to "nice or easy" numbers. Decimals, non-integral quotients

and large numbers and problems can more easily be solved using calculators."

"Some students can attempt difficult math problems they would think of trying with paper and pencil."

"The gifted or advanced student would be challenged by exploring advanced math problems and concepts."

On the question "What grade levels are best suited for the use of calculators?" the majority (45%) selected the upper grades, junior and high school. The remainder (55%) thought calculators could readily be used at elementary as well as the high school levels. The comments were categorized by grade level and areas of curriculum development.

1. Primary Grades (K-3).

B. Recommend usage of calculators to:

1. Develop an understanding of the number system.

a) Provide additional practice with number sequencing and number recognition.

b) Develop place-value concepts.

c) Provide additional drill with basic facts.

d) Become more familiar with basic operations performed on numbers and number patterns.

e) To aid in introducing the concept of fractions.

f) To help the student become proficient in estimation.

g) Reinforce the base ten system (i.e. - metric, money.)

2. To concentrate on problem solving skills.

3. To promote success in arithmetic for slow learners.

4. To challenge the gifted student.

2. Middle Grades (4-6).

A. Reinforce and follow-up of ideas in grades (K-3) above.

B. Develop objectives for hand-held calculators in the curriculum at each grade level.

C. Each grade level and/or department should:

1. Integrate calculators into the curriculum by means of various topics such as:

a) Science - interpreting data
- measurement
- metrics

b) Math - money estimation
averages place value
story problems

c) Economics - consumer education

d) Social Studies - map skills

2. Utilize calculator activities that correlate with the scope and sequence of their math texts.

3. Grades (7-12)

Uses:
- In review for preparation for high school placement tests.
- To reinforce fractions, decimals, and related patterns.
- Review concepts rather than tedious calculations.
- Formula work - quick calculation (areas and volumes).
- To promote creativity in students to develop own games and problems.
- Creating math lab activities to reinforce concepts.
- Solve statistical problems and their application.
- Use to aid in the solution of real life problems.
- To check answers and formulii of algebratic problems.
- Introduction of programmable calculators to calculate commissions, mortgages, taxes and interest.

The following recommendations were made regarding teacher training:

Staff Development

Staff Development Program should be sufficient to meet

the objectives established for each of the grade and/or department levels: Primary, Intermediate, Junior High, Senior High.

Suggestions include:

1. In-service workshops.
2. In-service credit or payment for courses.
3. Funds for resource people, professionals, video-taped lessons.
4. Released time to observe programs functioning.

Facilities (beyond those available through an individual school district) for providing in-service training should be:

a) Universities and college extension programs.

b) Universities and college short courses.

c) Facilities such as a Learning Center or Teachers Center. -- The Teachers Center should also provide facilities for staff development in the use hand-held calculators.

5. Schools should train their own teachers to use calculators proficiently and have one "very proficient", or trouble-shooter teacher, to help out with teaching problems. Could be another professional, or a resource, to help with teaching problems.
6. <u>All</u> faculty must be supportive so there is no one

undermining the program. All personnel must be convinced.

7. Some guidelines should be established on using calculators.

In addition to these suggestions additional research should be done to discover the "best" use of calculators in teaching and learning.

The participants in the workshop and survey were asked to list materials needed to implement and develop a calculator program in their school:

Materials

- Supply enough calculators for largest class in school. (It is important that they are of the same make.)
- Booklet with an outline format with definite concepts and skills you can use according to grade level.
- Individualized packet for student enrichment.
- Teacher packets that can be used in classroom situations.
- Identifying the use of the calculator in subject matters other than Math and Science; setting up packets to be used.
- Identifying the model of calculator used.
- Identifying the updated resource material available.
- Learning Center activity books.

Summary:

A survey was made to determine opinions and recommendations of teachers regarding the use of hand-held in the classroom. The findings favored their use. However, there was some reservation (58% against) about using calculators to check answers. Understanding of the process and the acquisition of basic skills should proceed use of calculators was agreed to by 100 percent of the sample. There was even greater resistance (63%) against the use of calculators on standardized tests or tests of basic skills, particularly at the elementary grade level. It could be permitted with advanced junior and high school students. Again, this suggessts a conservation posture by the teachers and administrators, i.e., the calculator is seen as an extension or adjunct teaching aide of the math curriculum.

The majority (95%-96%) of the sample felt students could profit from the use of the calculator in terms of enhancing creativity and learning mathematics, respectively. This suggests that teachers and administrators were favorably impressed with the advantages of using calculators in the classroom. On the other hand, the majority (97%) wanted some restrictions and guidelines on their use in terms of subject areas and activities. The sample was divided (45% to 55%) on whether the appropriate grade level for calculators should be the upper

grades or the elementary grades. The trend appeared to favor the upper grades in terms of effective and efficient use of the calculator. This judgement is difficult to verify until calculators have been used for a number of years.

The results of the survey are encouraging in that the teachers and administrators considered the calculators as an institutional aid and saw many possibilities of its implementation in the classroom. On the other hand, they were realistic as to their application and the need for guidelines.